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EDITORIAL NOTE

The Council of the Western Australian Naturalists' Club (Inc) conducted a survey of members regarding frequency and format of *The Western Australian Naturalist*. Overwhelmingly, members supported the continuation of publishing original data on all branches of natural science pertaining to Western Australia. Members also supported retaining the previous editorial style.

Members have been concerned at the cost of publishing a quarterly journal and accepted a less frequent but larger publication.

Accordingly Council has decided to publish the Journal twice yearly in March and September. Each part will be at least twice the size of the previous quarterly parts. This will reduce production costs without any reduction in the numbers of published pages.

JOHN DELL
(Hon. Editor)

OBSERVATIONS OF CAPTIVE AND WILD WESTERN RINGTAIL POSSUMS *PSEUDOCHEIRUS OCCIDENTALIS*

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INTRODUCTION

Common Ringtail Possums, *Pseudocheirus peregrinus*, of south-eastern Australia have been the subject of a number of studies: field studies of natural populations have provided details of population biology, natural history, growth and reproduction (Thomson & Owen 1964; How *et al.* 1984; Pahl 1987a); Chilcott and Hume (1985) and Pahl (1987b) have studied diet and digestion; Hughes *et al.* (1965) and Pahl and Lee (1988) reported on reproduction in natural populations.

The ringtail possums of south-western Australia have been considered as a subspecies, *P. peregrinus occidentalis*, though Thomas (1888) accorded specific recognition to the south-western ringtails (herein referred to as Western Ringtail Possums). More recently, McKay (1984) suggested that *P. occidentalis* probably warrants species status. The Western Ringtail Possum was given rare and endangered status by the Western Australian government in 1983. How *et al.* (1987) reported an alarming decline in this possums' range.

There have been no published accounts of the biology of Western Ringtail Possums. Between 1969 and 1974, one of us (M.E.) made observations, which are summarised in this paper, of a captive group and two natural populations.

CAPTIVE ANIMALS

Of the eighteen Western Ringtail Possums kept in captivity, six were collected from the wild, one from East Augusta and five from Two Peoples Bay. A male collected in suburban Perth was assumed to be an escaped pet. Possums were kept at M.E.'s home until December 1971 and were held in three cages of wire mesh (1 m square and 2 m high, 3 m x 2 m and 2 m high and 2 m x 1 m and 2 m high) with solid roofs and nest boxes. The possums were subsequently moved to CSIRO's Helena Valley establishment where they were housed in the same cages plus another (4 m x 3 m and 4 m high) of similar construction.

Diet

All possums were given a vitamin and mineral supplement daily ("Petvite") and a ration of Peppermint (*Agonis flexuosa*) leaves. The possums showed a preference for fresh, young, green leaves rather than young leaves with red colouring or older foliage. A variety of other plant materials formed the remainder of the daily ration, according to availability. These included commercially available fruits and vegetables, banana leaves, fuschia leaves, hibiscus and rose flowers, tamarix leaves and bark, biscuits, Marri (*Eucalyptus calophylla*) and Bullich (*E. megacarpa*) leaves.

Water was available at all times. Some possums were regularly observed drinking while others did not appear to drink.

On one occasion, an adult female was seen consuming her faeces.

Behaviour

Scent marking

Both males and females were observed to mark tree limbs with fluid from the cloaca. This behaviour was commonly observed when an animal was moved to new surroundings, and especially if another possum had previously marked the limbs. On one occasion, an animal was observed to deposit fluid directly over that previously deposited by another possum.

Vocalisation

Captive animals were heard to make a challenge or warning bark that consisted of two to four short syllables.

Social behaviour

Some combinations of possums sharing cages resulted in fighting. Peaceful combinations usually consisted of a female and her offspring, including mature daughters. Adult males were often not tolerated by mature females, though males rarely initiated agonistic behaviour. It was clear some possums recalled previous fights since placing a male into a bag (for weighing) that smelled of a female who had attacked him, elicited uncharacteristic distress.

Possoms were provided with nest boxes in their cages. Commonly, adult possums rested alone in the same nest box on consecutive days. Adult females shared their nest box with their young until the pouch-young was about 90 days old and nearly ready to make the first emergence from the pouch. The older sibling was evicted from the mother's nest box at this stage. On one occasion, an adult female and male shared a cage with their first young. When the next young was about 90 days old, the mother refused entry to the nest box to the elder daughter, who commandeered the male's box. The male moved into another (vacant) box. Occasionally an adult female shared its mother's nest box, and on a few occasions, a female just evicted from its mother's box shared a male's nest box. Rarely did an adult female share a nest box with an adult male.

A number of agonistic encounters were observed when a new possum was introduced to an already inhabited cage. Four types of attack were recognized:

1. swipe — front paw extended as in a slap
2. bite
3. scratch
4. 'tangle' — a full embrace with biting

Biting and scratching were usually aimed at either the head or tail of the opponent. Most aggressive encounters observed occurred when a male and female were put together (for mating), and were terminated by the observer removing the introduced possum. No submissive behaviour was observed; if an animal attempted to avoid conflict, it sat still as far as possible from the opponent.

On two occasions aggression between cage cohabitators was observed prior to the death of a possum. In one case, a female with two young, male offspring was collected from Two Peoples Bay when the young weighed ca. 170 g. Twenty weeks later, the two young were ca. 850 g. One evening, one of the twins was observed to be chasing its sibling. The next morning the sibling was found dead with extensive head injuries. On another occasion, an adult female was apparently killed by an adult male three days after being introduced into his cage.

Copulation and birth were never observed, though as mentioned earlier, on rare occasions an adult male and female shared a nest box.

Sex ratio

A total of 11 young were born to four females; five of these were male and six were female. This sex ratio did not differ from unity ($\chi^2_{0.05} = 0.90$, 1 d.f., $p > 0.05$).

Litter size

On one occasion, two young (one female, one male) were born to a female which was born in captivity and had previously raised one young. One of the twins (the female) was found alive on the cage floor at ca. 35 g (ca. 50 days of age) and returned to the pouch. Two days later, it was dead.

Nine of the 11 young born appeared to be single births suggesting that 10% of births are of twins.

Fecundity

Data on the fecundity of captive females are limited because few lived longer than two years in captivity, and some did not have access to males. However, the best record of subsequent births was that of the first captive female collected as a subadult; it had almost constant access to a male. This female successfully raised four young during the first two years of maturity with the first three births occurring within one year (Figure 1). The greater period of time between the last two births may relate to the female's health; the growth of the last young appears slower than that of her earlier offspring.

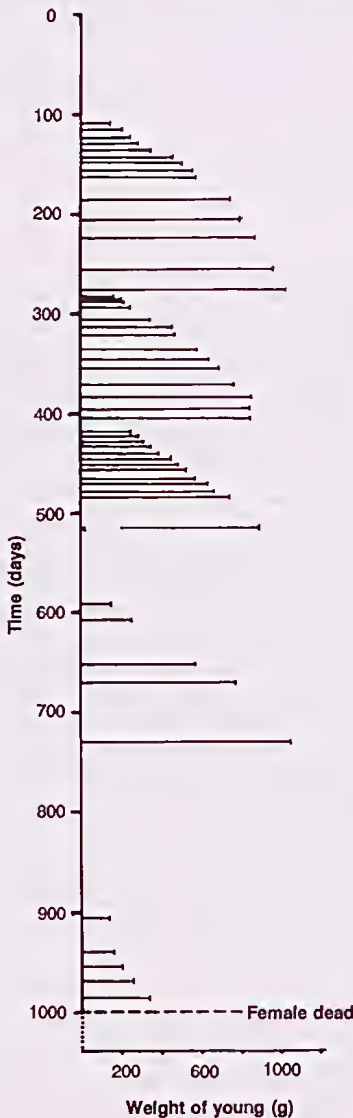


Figure 1: Reproductive chronology for the captive female with the longest reproductive life. Horizontal lines represent the weight of five successive young.

Growth of young

The growth of five young (three females and two males) was documented by frequent weighing starting about the time of first emergence from the pouch. Four of these young were fathered by a male of unknown geographic origin; the mother was from East Augusta. The fifth was the young of the first two (siblings) of the above pair.

The Non Linear Regression sub-programme of SPSSx (SPSS Inc. 1988) was used to compare the relative fits of the growth data to logistic, Gompertz and von Bertalanffy growth curves. Linear regression was used to check the suitability of a straight line growth model. The linear regression yielded a coefficient of determination (R^2) of 0.88 and all curves tested yielded an $R^2 = 0.96$. The von Bertalanffy equation (Cumulative growth (W) = $a(1 - be^{Kt})^3$, where a is the asymptote of the curve, b is the corrected, average slope and K is the derived, initial mass) (Ricklefs 1968) provided the lowest weight at time zero (23 g versus 100 g and 116 g for the logistic and Gompertz equations, respectively). For our data, the equation was:

$$W = 1025 (1 - 0.016 e^{23t})^3.$$

Clearly, the model's ability to extrapolate birth weights for pouch-young was impaired by our limited data on pre-emergence weights.

Because the date of birth was not known for any of the five young, individual growth curves were matched (for time) at a body weight of 200 g (Figure 2).

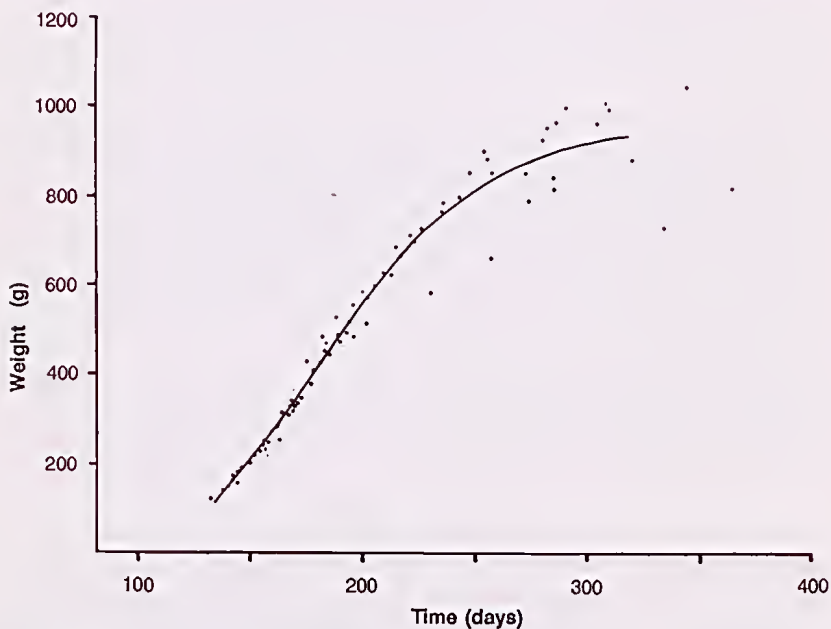


Figure 2: Growth of captive Western Ringtail Possums: most weights were taken after the first emergence from the pouch. Equation for the curve that best fitted the data was:
 $W = 1025 (1 - 0.016e^{23t})^3$.

The best estimate of the duration of pouch life is based on the smallest young seen which was viewed when crown-rump length was ca 1 cm. This was 95 days prior to the young's first emergence at a body weight of 125 g. All ages referred to throughout these notes assume a pouch life of 100 days.

The observations cannot be used to suggest a gestation period or the duration of lactation. One female with a young of 500 g (age ca. 160 days) had one functional teat, and this was at least 40 days prior to the birth of the next young.

Young attained adult body weight (900-1000 g) at about 260 days.

Two females born in captivity produced young which were first detected when the mothers were 305 and 320 days old with body weights 1000-1100 g. Other females reproduced at body weights of ca. 900 g, but their age was unknown.

Causes of death

Fourteen possums (seven captive bred, and seven wild caught) died in captivity. The following list gives the animal's gender, age and circumstance of death for those possums that were born in captivity.

female; 22 months; post mortem revealed impacted stomach with secondary liver degeneration and lack of body fat

female; 32 months; 'accidentally' killed by pet dog

female; 31 months; accidental overdose of anesthetic

male; 14 months; sick (no response to penicillin) then dead

male; 10 months; post mortem showed lung degeneration

male; 5 months; sickened and died after mother's death

female; body weight 35 g; found on cage floor (its twin was still in the pouch)

The following list gives the animal's gender, the period it was kept in captivity, and its age at capture for possums collected from the wild.

male; 42 months; killed for post mortem, cause of illness focal hepatitis (*Corynebacterium xerosis* cultured from liver)

male; 2 months (adult); sickened and died (cause unknown)

female; 40 months (subadult); post mortem inconclusive, possible heart attack

female; 16 months (adult); unknown

male; 4 months (back young); killed by its twin

male; 8 months (back young); unknown, redback spider found in nest box

female; 3 days (adult); killed by male

WILD POPULATIONS

Drey use

Opportunistic observations of natural populations of Western Ringtail Possums were made at East Augusta and at Two Peoples Bay. Like the Common Ringtail Possum, the Western Ringtail Possum used dreys constructed from flexible twigs and vegetation for daytime shelter at both sites. Observations of the dreys were the main source of data in this section.

The shape and dimensions of a typical drey from East Augusta are shown in Figure 3. Dreys were located in trees or shrubs, often in dense clumps of vegetation such as vines or creepers. Twigs of Peppermint usually formed a major part of the drey; other materials observed included sedge leaves and bracken fronds which were available only from ground level.

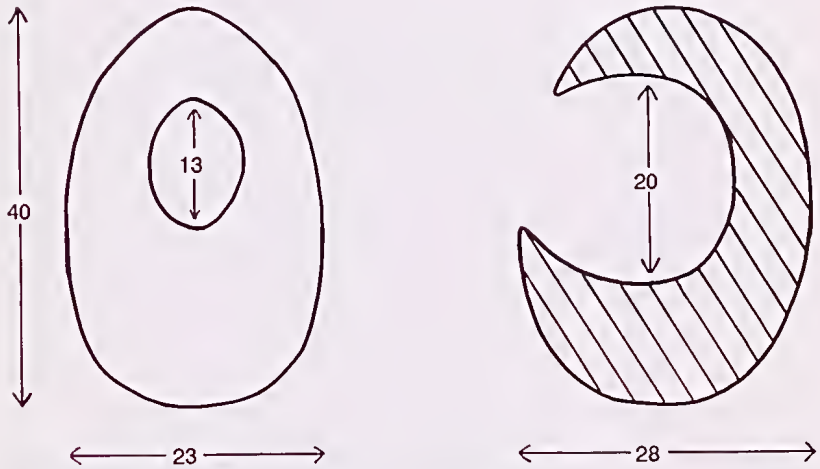


Figure 3: Shape and dimensions (cm) of a typical drey from East Augusta.

The height above ground of 14 dreys was recorded at each locality. At East Augusta the average height was 5.4 m (2.4-8.2 m), significantly higher than that at Two Peoples Bay, 1.6 m (0.6-3.6 m) (Student's $t_{27} = 8.30, p < 0.005$). At Two Peoples Bay, dreys were often located in shrubs of the understorey (below trees to 8 m), while at East Augusta, most dreys were in the trees (*A. flexuosa* to ca. 10 m) and the understorey was primarily of sedge and bracken.

At Two Peoples Bay, dreys at a number of sites were checked for occupancy. One hundred and three dreys were checked of which eight were occupied, giving an occupancy rate (number of dreys occupied by a ringtail/total number of dreys checked) of 8%.

At East Augusta 32 dreys were tagged between 1969 and 1972, all of which were occupied by a possum at some time. During four years, six marked dreys became derelict either falling from a tree or breaking apart. Persistence of dreys ranged from six months to at least 38 months.

A drey marked M11 was used for 38 months by at least three different possums. Records of the occupancy for this drey are shown in Table 1.

Table 1. Records of occupation of a single drey (M11) at East Augusta. The "O" denotes that the drey was occupied; the "E" empty.

Day	Drey	Occupant(s)
1	E	
337	E	
399	O	female and young
426	O	female (adult)
623	O	female and large young
624	O	unknown
625	O	unknown
645	E	
677	E	
688	O	male
735	O	unknown
766	O	unknown
767	E	
806	E	
807	E	
808	E	
813	O	female and young
837	E	
841	E	
843	E	
1045	O	male
1046	E	
1069	O	female (subadult)
1071	E	
1172	drey broken up	

Within one month of M11 breaking up, a new drey was built in the same position.

Summarising, the occupancy rate for all marked dreys at East Augusta showed 40% of dreys checked were occupied, while for M11 the occupancy rate was 45.8%.

On one occasion, three possums (a female with two young) were flushed from a drey at Two Peoples Bay. All other dreys were occupied by a solitary male or female, or a female and young.

Field weight

Adult possums were caught at both localities. From East Augusta, seven females had a mean weight of 1057 g (960-1100 g) and three males 1102 g (950-1250 g). From Two Peoples Bay, two females weighed 1080 and 1040 g and three males had a mean weight of 1078 g (1000-1160 g).

DISCUSSION

Comparing these observations of the Western Ringtail Possum with reports of the biology of the Common Ringtail Possum (Thomson and Owen 1964; How *et al.* 1984) shows a number of differences between the species. Drey occupancy results suggest social behaviour of the two species differs. In this study, Western Ringtails were never observed sharing nests, except for females with young. Thomson and Owen (1964) found adult Common Ringtails shared dreys in a variety of combinations; about half of the dreys contained a single animal, one third were occupied by a pair (male and female), and the remaining dreys contained the rarer cases of more than two adults or two adult

males. Observations of captive Western Ringtails suggest that drey-sharing may occur, but the field observations indicate adults do not share dreys on a regular basis, and that if drey-sharing does occur naturally, it is an unusual event.

Adult Western Ringtail Possums weigh about 950-1100 g, being considerably heavier than Common Ringtail Possums from Victoria (ca. 700-900 g). Most births were single in Western Ringtails, but twins are the norm for Common Ringtails. This suggests that the growth of young is likely to differ also, but our data are too sparse to comment with any confidence.

Smith and Lee (1984) describe trends in body size and reproductive patterns for Australian possums and gliders, and show that larger species tend to have smaller litters. They also suggest that the low nutritional value of a herbivorous diet may provide a selective advantage that encourages the evolution of larger body size. Applying these concepts to the major differences between the Western Ringtail Possum and the Common Ringtail Possum prompts the suggestion that Western Australian habitats may offer a lower quality food resource than that available in the eastern states. The more solitary social arrangements of Western Ringtail Possums may also be a response to a lower quality food resource. Further studies of dispersion patterns may allow evaluation of these suppositions.

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NOTES ON THE DISTRIBUTION, ECOLOGY AND TAXONOMY OF THE PEACEFUL DOVE *GEOPELIA STRIATA* IN WESTERN AUSTRALIA

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ABSTRACT

Data on distribution, abundance, habitat, food, breeding, and colour of unfeathered parts are given for the Western Australian populations of *Geopelia striata*. Geographic variation is analysed (briefly also for eastern Australia and New Guinea). The Peaceful Dove is treated as conspecific with the Zebra Dove *G. s. striata*. Only one subspecies *G. s. placida* is recognised in Australia and New Guinea.

INTRODUCTION

All three geopelias inhabiting Australia, the Bar-shouldered, Peaceful and Diamond Doves are superficially similar in plumage, displays and calls, causing some field workers to wrongly identify them; even recent texts give erroneous distributions for Bar-shouldered and Peaceful Doves in Western Australia. In